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ABSTRACT

This paper discusses a study designed to evaluate the use of semantic and syntactic expectations in reading. Sixteen college-student subjects, measured for reading proficiency by the Nelson-Denny Reading Test, were divided equally into a fast-reading group (350-450 words per minute) and an average-speed reading group (200-275 words per minute). Subjects had approximately equal comprehension scores, and they were motivated by a payoff scheme to read three sets of 48 three-sentence stories as quickly as possible without loss in comprehension. The story sentences were structured and presented so that varying levels of semantic and syntactic expectation occurred. Results of the study show that fast college readers can use a semantic or a syntactic clue more or less independently of one another, while average college readers tend to combine the two sources of expectation. The paper suggests that trying to use both types of clues at the same time produces redundant information, thus wasting some of the already limited space in working memory. The report concludes by advocating an increased emphasis of clue-search characteristics in reading instruction. (RL)

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LINGUISTIC EXPECTATIONS AND MEMORY LIMITATIONS IN READING

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Paper presented at the twenty-second annual convention of the International Reading Association, Miami Beach, Fla.

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Linguistic Expectations and Memory Limitations in Reading

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There has been a widespread acknowledgment of the utility of linguistic expectations during reading (Goodman, 1971). Within a sentence, a reader's anticipation of syntax influences the identification of words and the specification of their meaning; between sentences, the context already established delimits upcoming meaning. Thus, a reader's expectations have both a syntactic and a semantic component. The present research investigates some operational characteristics of linguistic expectations in reading, and examines whether the characteristics differ between good and average college readers.

Reading incorporates perceptual and linguistic processes, each embracing an assemblage of subtasks. Some are executed automatically (LaBerge and Samuels, 1974) but others require effortful decision making (Posner, Lewis, and Conrad, 1972). Since a reader's performance is bounded by the processing limitations of short-term memory, skilled reading requires that this facility be used efficiently. Recently, experiments by Perfetti and Goldman (1976) and Perfetti, Bell, and Goldman (1976) call for a language-specific memory function not wholly dependent either on decoding or on simple short-term memory capacity. The important question is not what that capacity is, but how it is used.

Memory limitations oblige a coordination of reading subtasks, and a reader's expectations can prime some of these subtasks. In this way, a reader's preparation can reduce processing load. Expectations, however, are neither generated nor tested in a piecemeal manner; rather, they are constantly updated and modified by the visual information currently available. Reading, then, may be regarded as an interactive process (Rumelhart, 1976a). The reader assimilate what is expected with what is seen.

Syntactic expectations stem from the highly predictable course of an English sentence: segmented into word-groups, each word-group separarated from its neighbor by a boundary marker, the groups occurring in a relatively fixed order, and the words in each group generally falling in a precisely fixed order (Gordon, 1957). Upcoming syntactic structures are often signalled, and readers are well aware of these markings. Kolers (1970) has reported that 70% of the oral reading substitutions of adults conform to the same part of speech as the correct word in a text. Even for first-graders, oral reading

errors do not violate preceding grammatical constraints (Weber, 1970). These studies, and many others, substantiate the expectancy of syntax in reading.

In addition to expecting syntax, the reader also anticipates meaning. Sentences are comprehended within a large knowledge framework, represented in memory by a complex network of interrelated propositions (e.g. Anderson and Bower, 1973). Equipped with a reader's total knowledge, memory can project the meanings that discourse is likely to intend. The various descriptions of connected discourse (e.g. Kintsch, 1974) differ in their propositional representations and heirarchical configurations; however, they usually share Bartlett's (1932) hypothesis that prose passages are stored in a schematic form and are assimilated into other thematic knowledge over time. Thus, when comprehending discourse, a theme might be abstracted and used in a heuristic fashion to anticipate meaning. The meaning intended by one sentence is redundant with the context specified by the previous sentences.

Empirically, the benefits of context for the comprehension process span from word recognition (Meyer, Schvanaveldt, and Ruddy, 1974) through intersentential relations (Haviland and Clark,1974) and inference production (Thorndyke,1976) to retention of prose (Dooling and Lachman, 1971). These findings reveal that context facilitates the various processes underlying comprehension. A popular explanation of this effect is that context arranges a "frame" (Minsky,1975) or a "schema" (Rumelhart and Ortony,1976) which defines the various expectations and within which incoming sentences can promptly be integrated. Thorndyke (1976) suggests that the comprehension of a sentence should occur rapidly when it is consistent with current context.

A theoretical description of the expectation construct follows. This description assumes that the goal of the reader is to fill in some linguistic schema, or pattern, which already exists in memory. Until the variables of the schema have been assigned values, comprehension cannot occur. A schema binds the meanings of and relations between words into a single, wholistic representation. This representation must "account for" the material to be comprehended (Rumelhart and Ortony, 1976). A schema serves as a cognitive template, against which new inputs can be matched.

A reader makes decisions in both the selection of the appropriate schema and in the specification of its variables. An expectation is the set of assumptions regarding the selection of the schema; further, nested in a schema is a set of variables to which the reader must assign values. Additionally, expectations regarding various grammatical forms occur on the surface. Thus, expectations arise at various levels of analysis, and all must blend with the limited-capacity characteristics of human information processing.

The experiment reported here assesses the processing characteristics of these linguistic expectations during reading. The rationale is to predispose expectations by manipulating what is known about some text before it is read. In particular, readers might have a knowledge about the grammatical patterns of a to-be-read sentence or they might be given a well-specified contextual setting. In some conditions readers will have both context and a knowledge of grammatical patterns. The effects of these manipulations will reflect in the reading rate. A key assumption is: the greater the influence of an expectation, the faster a sentence will be read. This assumes, of course, that the level of comprehension remains constant.

Subjects read sentences that either do or do not follow from preceding "context" sentences. This is accomplished by constructing a triad of sentences that either form a story or are unrelated. Independent of semantic considerations, the syntax of some sentences will be known before they are read. This allows for an appraisal of whether semantic and syntactic expectations together can further reduce reading time.

METHOD

Subjects - All subjects were undergraduates at the University of California, San Diego. Subjects were recruited on the basis of their reading speed and comprehension. Reading proficiency was measured on the Nelson-Denny Reading Test (Form B). The criterion for the FAST group was between 350 and 450 words per minute (80'th to 95'th percentile); for the AVERAGE group, the criterion was between 200 and 275 wpm (30'th to 65'th percentile). All subjects' comprehension scores were in the upper quartile.

The 16 subjects, eight in each group, were paid $1 for participating in the reading test and were paid according to their performance in the experimental session, averaging $4 for the 75 minute session.

Stories - Over 200 three-sentence stories were collected. Over 100 were written by a high school English class; the remainder were collected from college students seeking experimental credit to satisfy a course requirement.

Each story comprised three sentences, each sentence having a well-defined functional relationship: the first sentence established a setting, the second described an event that occurred within that setting, and the third specified a reaction consequent to that event. The structure of the stories follows from Rumelhart's (1976b) story grammar. For all of these setting-event-reaction stories, the first two sentences did not exceed 10 words each, and the third sentence did not exceed 15 words. Examples of some stories appear in Table 1.

In addition to the semantic constraints between sentences, the syntax of the third sentence followed certain guidelines. For some stories, the syntax, or style, of the third sentence followed the following formats:

Style 1: Adverbial Adjunct, Subject, Verb Phrase, Verb Phrase, Verb Phrase

Style 2: Dependent Clause, Independent Clause

Stories A and B in Table 1 have their third sentences written in Style 1; stories C and D are written in Style 2. These stylistic restrictions on the third sentence affect only half of the stories. For the remainder, the syntax of the third sentence was left to the writer, as long as it differed form Style 1 and 2. There were no stylistic restrictions on the first two sentences of the story.

The stories were corrected for spelling and grammatical errors, and a few sentences were shortened when they exceeded the pre-specified length. They were then parsed into phrases, and edited whenever a phrase exceeded four words. The editing, however, preserved the meaning of each sentence, removing mainly adjectives and adverbs.

One hundred and forty-four stories were randomly selected from the pool and assigned to the experimental session, 48 with the third sentence in Style 1, 48 in Style 2, and 48 others. The remaining sentences were either used for the practice session or converted into anomalous stories for the comprehension monitor describe below.

Altogether, over 40 persons generated the stories. Hopefully, this made for a random sample from a broad semantic database, allowing for generalizations to the story grammar used.

Design - The stories had two presentation formats: SEMANTIC or NO SEMANTIC. When the former, the three sentences that constituted a story were read in sequence; when the latter, the first sentence was randomly drawn from the the first sentence of one story, the second sentence was from the second sentence of another story, etc. The intent was to have a strong semantic dependence between sentences in the SEMANTIC format and a weak dependence in the NO SEMANTIC format. The selection of sentences to presentation format was counterbalanced between subjects.

The first and third set of 48 stories were not blocked for the style of their final sentence, but the middle set of 48 was. This blocking predisposed syntactic expectations for the third sentence. Throughout, the stories were staggered, in sets of 12, for being blocked in the SEMANTIC or the NO SEMANTIC format. This blocking predisposed semantic expectations.

Thus, there were two between-subject factors: Reading Group (2 levels - FAST or AVERAGE) and Sentence Selection (2 levels for counterbalancing); and three within-subject factors: Semantic Expectations (2 levels- Yes or No), Syntactic Expectations (2 levels- Yes or No), and Sentences (3 levels - setting, event, reaction).

Procedure - Before the experiment, subjects were informed of the story grammar and of the semantic relations between sentences of a story. They were given numerous examples. They were told of the syntactic format of the third sentence and were instructed on the two blocking procedures: (1) stories would be read in sets of 12 that were either inclusively in the Semantic or in the No Semantic format; and (2) some sets of stories would be blocked according to the syntax of their third sentence, independent of being Semantic or No Semantic. During the course of the session, notices in blocking changes appeared at the appropriate times.

Before each story, the word READY appeared on the display scope. When prepared, the subject pressed a button, read the first phrase of sentence one, and requested each subsequent phrase with a button press, continuing until a blank screen signalled the end of the story. The reading time per phrase was recorded to the nearest msec.

Subjects read 16 practice stories from which a mean reading time was computed. Subjects were motivated to read as quickly as they could through a payoff scheme that compared experimental to practice reading times.

Two comprehension monitors were used. For the first, subjects were required to rate the meaningfulness of 48 sentences, dispersed throughout the session and equally among the three sentences of a story. For the second monitor, subjects had to decide which of four words appeared in the sentence just read. These 18 recognition tests were distributed throughout the session and equally among the three sentences of a story. A payoff scheme motivated comprehension.

Results and Discussion

All subjects performed well on both comprehension monitors; overall, recognition of the phrases exceeded 96% correct and judgements of the anomalies exceeded 90% correct. Since a preliminary analysis of the counterbalancing factor revealed no effect, it was collapsed for the remaining analyses.

Semantic Expectations - The SEMANTIC condition had an increasing effect across sentences of a story. When one sentence followed from the preceding sentence, reading times decreased by 3, 9, and 12 percent across sentences 1, 2, and 3 respectively. Of interest is the effect of the third sentence. Here, semantic expectations are highest

and, unlike the first two sentences, manipulation of syntax was possible. The remainder of the results will be limited to the data from this experimentally critical sentence.

Of theoretical interest is the effect of knowing the syntax of the third sentence, and whether this knowledge is affected by semantic expectations. To examine this, the reading times of the third sentence were drawn from the data for sentences written in Style 1 or 2. There are four relevant combinations of these data. The first considers the NO SEMANTIC condition, the second the SEMANTIC condition, the third the NO SYNTAX condition (Style 1 and 2 mixed), and finally the SYNTAX condition (Style 1 and 2 blocked).

NO SEMANTIC - The data are plotted in Figure 1. For the FAST group of readers, knowing the syntactic format when no semantic expectations are available has a marginal effect by the conservative quasi F-ratio, $\underline{F}'(1,7) = 3.4$, $p=.1$ (otherwise, when the syntax factor is tested against the subjects by syntax interaction, $p < .05$). For the AVERAGE group, the effect is similar: $\underline{F}' (1,7) = 2.9$, $p=.12$ (otherwise, $p < .05$).

SEMANTIC - The data are plotted in Figure 2. For the FAST group, the benefit of a semantic expectation overrides any effect of a syntactic expectation, $\underline{F}'(1,7)=.27$, $p=.6$ (otherwise, $p=.9$). For the AVERAGE group, $\underline{F}'(1,7) =1.74$, $p=.22$ (otherwise, $p=.07$). The interaction between groups was not significant ($p =.19$).

Clearly, for the FAST group, semantic expectations negate any influence of k knowing the syntactic format. For the AVERAGE group, there is a tendency for the same, but it is not nearly as strong.

NO SYNTAX - The data are plotted in Figure 3. When no prior information concerning the syntax of the sentence is known, both FAST and AVERAGE readers utilize semantic expectations, $\underline{F}'(1,7) = 7.3$, $p < .05$, and $\underline{F}'(1,7) = 8.2$, $p < .05$, respectively. The interaction is not significant ($p=.23$).

SYNTAX - The data are plotted in Figure 4. When syntactic expectations are present, the FAST group is not affected by semantic expectations, $\underline{F}'(1,7) =.84$, $p=.39$. In contrast, AVERAGE readers are strongly influenced by semantic expectations in this condition, $\underline{F}'(1,7) = 9.24$, $p < .05$.

Apparently, FAST readers ignore the semantic clues when syntactic format is known. AVERAGE readers, on the other hand, combine both of these linguistic clues to reduce reading time. (Remember, the task is to read the sentences as quickly as possible).

Subjects read faster when a prior knowledge of structural organization of the (third) sentence was available. When semantic expectations were manipulated along with syntactic expectations, systematic differences between groups of readers emerged. These differences expose a distinguishing characteristic between levels of accomplished reading achievement. Taken together, these results say that fast college readers can use a syntactic or a semantic clue more or less independently of the other, whereas average college readers tend to combine these sources of expectations.

The fact that readers use expectations in different ways promotes an interpretation based on a selectivity mechanism sensitive to various aspects of linguistic input. Apparently, the fast reader tends to select from either a semantic or a syntactic source and schedules the components of reading around those expectations. In contrast, the average reader appears to be less selective, merging these expectations. Perhaps this mergence hinders their efficacy as clues: the average reader must time share between expectations whereas the fast reader selects one or the other and uses that single input more effectively.

The effectiveness undoubtedly depends on the fact that the cognitive mechanisms fundamental to reading have a limited capacity. Expectations allow the reader some foresight while establishing referents, building context, priming various processes, etc. Here, the emphasis is on organization. It is unlikely that readers av varying levels of achievement differ in their memory capacity. The difference in achievement must, in part, stem from how information in those limited-capacity mechanisms is supplied, operated on, and maintained.

The reader wishes to select and then complete a schema. When semantic and syntactic information concerning the to-be-completed schema can be assumed, the fast reader prefers the syntactic assumptions. Perhaps information from a semantic expectation is used independently from the limited capacity mechanisms. Here, a spread of activation (Collins and Loftus, 1975) may delimit the search for meaning variables in the schema. This search

might be guided by syntactic considerations. For fast readers, semantic processing might proceed with greater automaticity (LaBerge and Samuels, 1974) than does syntactic processing.

A Language-Specific Memory Function

Recently, Perfetti and Goldman (1976) argue for a language-specific memory function beyond mere short-term memory capacity. Their argument appreciates that the complexities of language processing demand coding and recoding of linguistic information and the effective distribution of attention among the components of comprehension. Several components of comprehension may simultaneously demand space in working memory. For instance, the use of syntactic clues to encode information and the accessing of previously processed information with new information may represent component processes operating at more or less the same time. Moreover, it is likely that there are individual differences in the degree to which such processing skills have been learned.

Perfetti and Hogaboam (1975) argue that the slow decoding that occupies the limited resources of working memory is a major source of comprehension difficulty. Of course, their argument may be extended to say that any unnecessary occupation of working memory retards the comprehension process, such as redundant syntactic computations and unlikely semantic interpretations. The experimental results here suggest that better readers prefer to consider clues from one linguistic source rather than juggle between sources. This might mean that the dual sources used here input information that is in some ways redundant, requiring unnecessary space in working memory. The fast readers realize this; the average reader is less aware.

Expectations in Reading

Readers have the capacity to take advantage of expectations. The fact that readers generate expectations during reading is well documented in the literature. The present experiment demonstrates that readers can implement strategies which utilize artificially-induced expectations. These strategies increase reading speed but do not reduce comprehension. Since a reader has this capacity, the next step is to devise methods that effec-

tively induce expectations in a natural setting. As Wardaugh (1969) states: "Many of the mistakes students make in reading are made because the students have adopted inappropriate strategies in their processing. In later stages of reading instruction, when the reading for implications and reading between the lines becomes an important part of instruction, the possibilities for adopting inappropriate strategies increases" (p.138) . Current reading instruction methods do not stress this potentially useful source of information. Kolers (1970) offers that the teaching of reading sould move away from the purely visual aspect and emphasize the clue-search characteristics of reading. For reading to be most effective, the reader should make full use of all the clues his language offers.

References

Anderson, J.R. and Bower, G.H. Human Associative Memory. New York: Wiley, 1973

Bartlett, F. Remembering. Cambridge: Cambridge University Press, 1932

Collins, A.M., and Loftus, E.F. A spreading-activation theory of semantic processing. Psychological Review, 1975, 82, 407-28

Dooling, D.J. and Lachman, R. Effect of Comprehension on Retention of Prose. Journal of Experimental Psychology, 1971, 88, 216-22

Goodman, K.S. Reading: a psycholinguistic guessing game. In H.Singer and R.B. Ruddell (Eds) Theoretical Models and Processes of Reading. Newark, Del: IRA, 1970

Gordon, C. How to Read a Novel. New York: Viking Press, 1957

Kintsch, W. The Representation of Meaning in Memory. Hillsdale, N.J.:Earlbaum, 1974

Kolers, P.A. Three stages in reading. In H. Levin and J.P. Williams (Eds) ,Basic Studies in Reading. New York: Basic Books, 1970

LaBerge, D. and Samuels, S.J. Toward a theory of automatic information processing in reading. Cognitive Psychology, 1974, 6, 293-332

Meyer, D.E., Schvanaveldt, R.W. and Ruddy, M.G. Loci of contextual effects on visual word-recognition. In P.M.A. Rabbitt and S. Dornic (Eds), Attention and Performance V, New York: Academic Press, 1975

Perfetti, C.A. and Goldman, S.R. Discourse memory and reading comprehension skill. Journal of Verbal Learning and Verbal Behavior, 1976, 14, 33-42

Perfetti, C.A. and Hogaboam, T. The relationship between single word decoding and reading comprehension skill. Journal of Educational Psychology, 1975, 67, 461-69

Posner, M.I., Lewis, J.C. and Conrad,C. Component processes in reading: a performance analysis. In Kavanagh,J. and Mattingly, I. (Eds) Language by Ear and Eye. Cambridge: MIT Press, 1972

Rumelhart, D. E. Toward an interactive model of reading. In S. Dornic (Ed) Attention and Performance VI, New York: Academic Press, 1976a

Rumelhart, D.E. Understanding and summarizing brief stories. In D.LaBerge and S. Samuels (Eds), Basic Processes in Reading: Perception and Comprehension. Hillsdale, N.J.: Earlbaum, 1976b

Thorndyke, P. Cognitive structure in human story comprehension and memory. Unpublished doctoral dissertation. Stanford University, 1975

Weber, R.M. First graders; use of grammatical context in reading. In H. Levin and J.P. Williams (Eds) Basic Studies in Reading. New York: Basic Books, 1970

Wardaugh, R. Reading: A Linguistic Perspective. New York: Harcourt, 1969

FIGURE 1

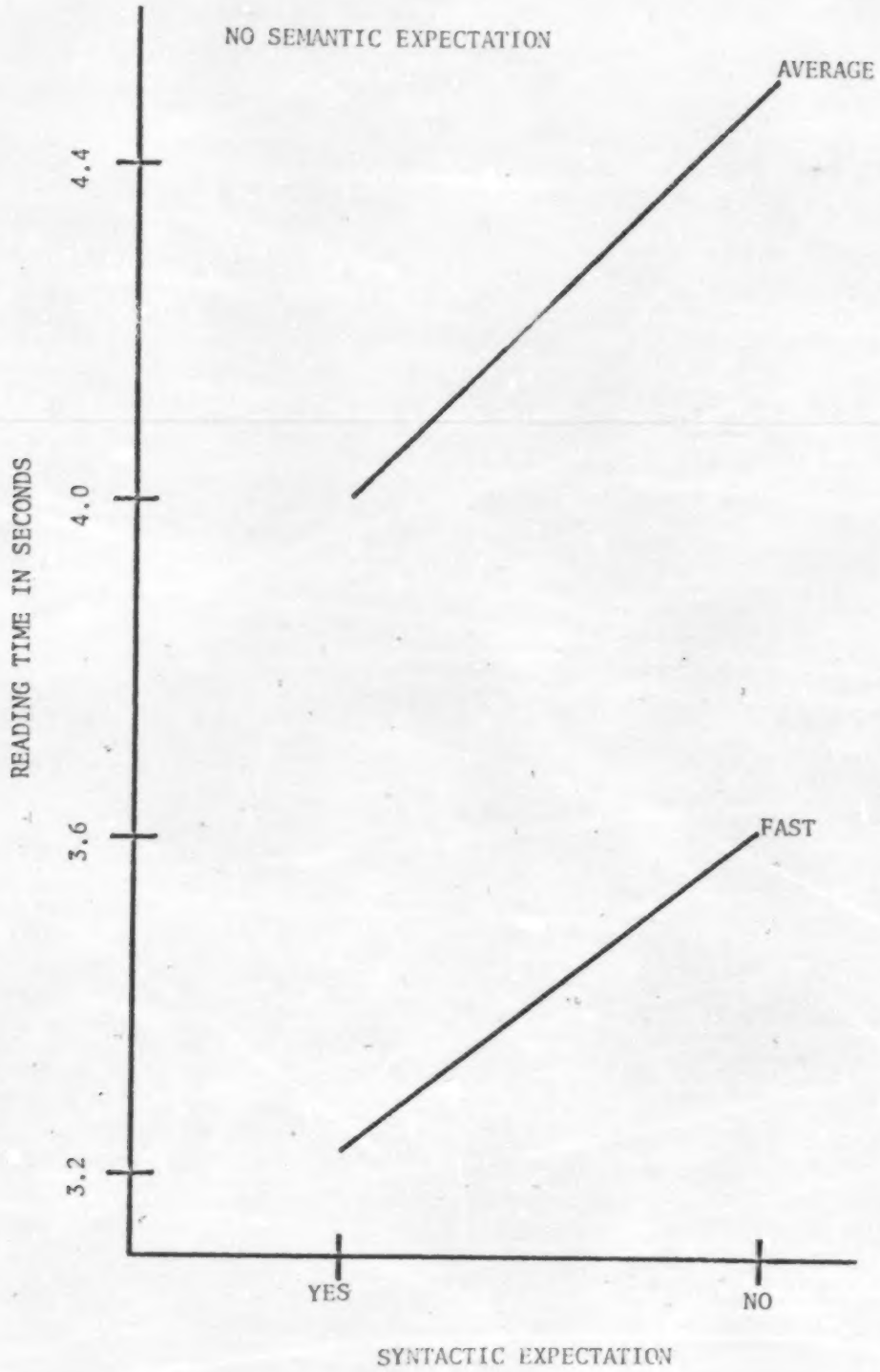
NO SEMANTIC EXPECTATION
AVERAGE
FAST
READING TIME IN SECONDS
4.4
4.0
3.6
3.2
YES
NO
SYNTACTIC EXPECTATION

FIGURE 2

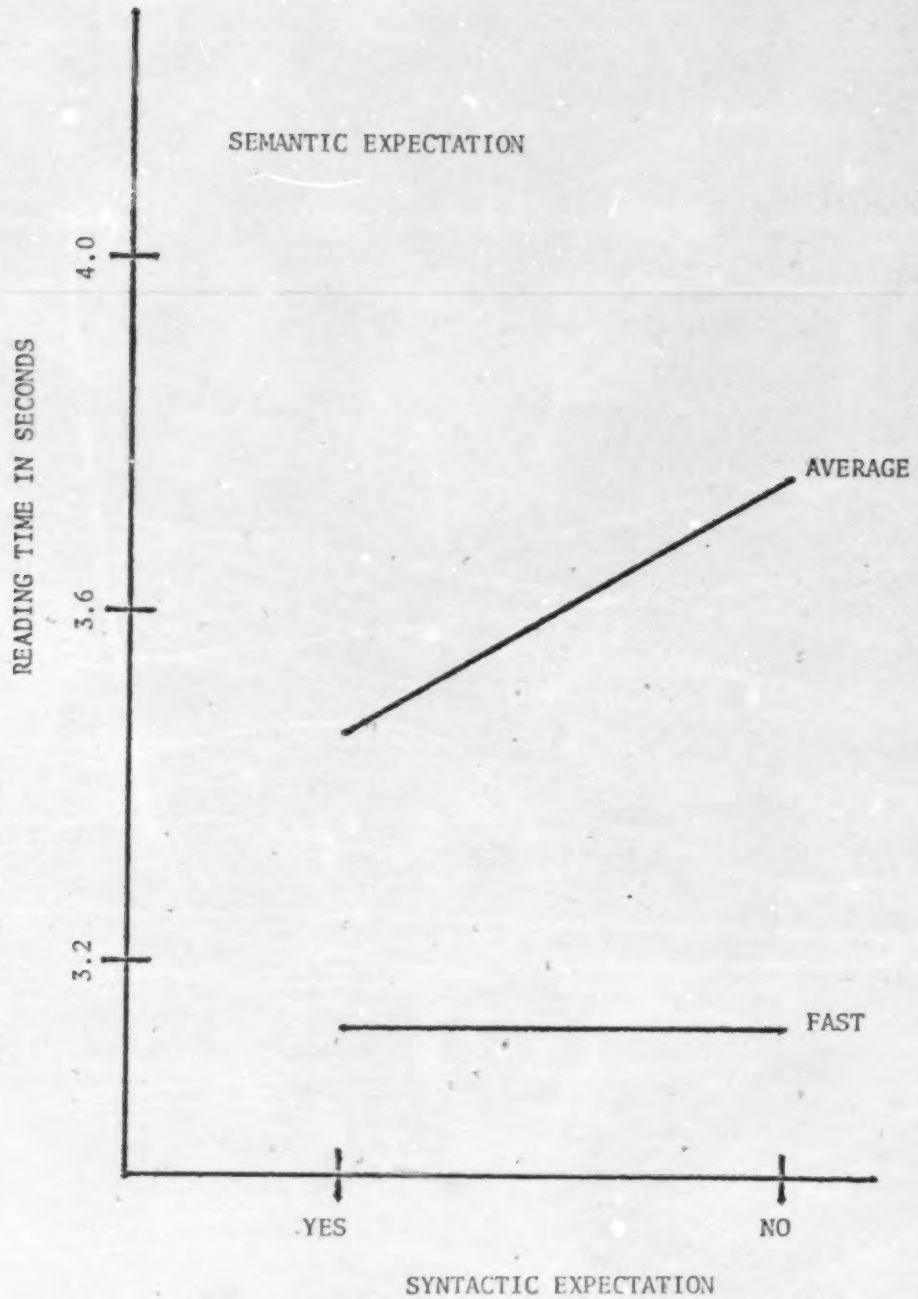
SEMANTIC EXPECTATION
4.0
3.6
3.2
READING TIME IN SECONDS
AVERAGE
FAST
YES
NO
SYNTACTIC EXPECTATION

FIGURE 3

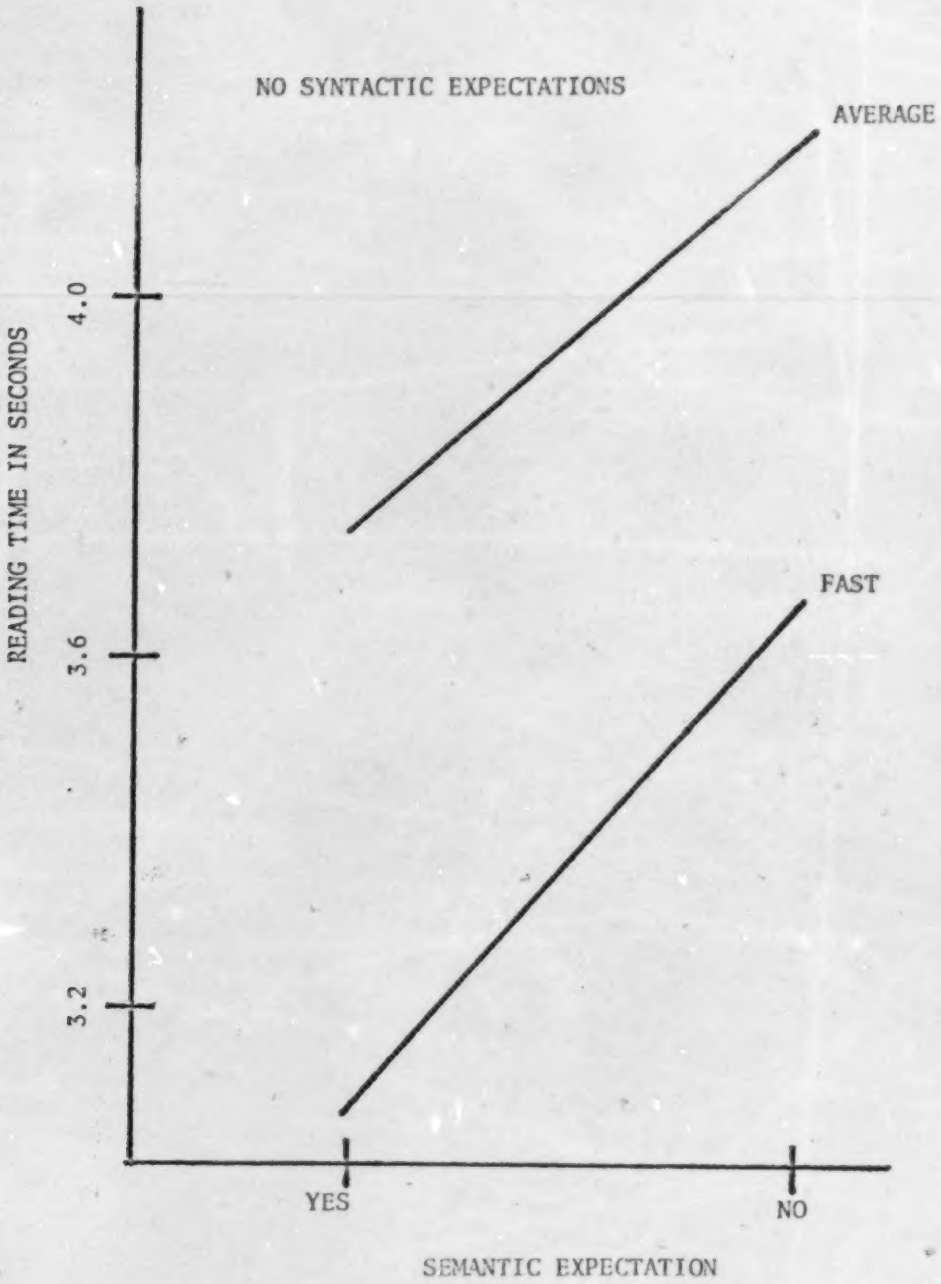
NO SYNTACTIC EXPECTATIONS
AVERAGE
FAST
READING TIME IN SECONDS
4.0
3.6
3.2
YES
NO
SEMANTIC EXPECTATION

FIGURE 4

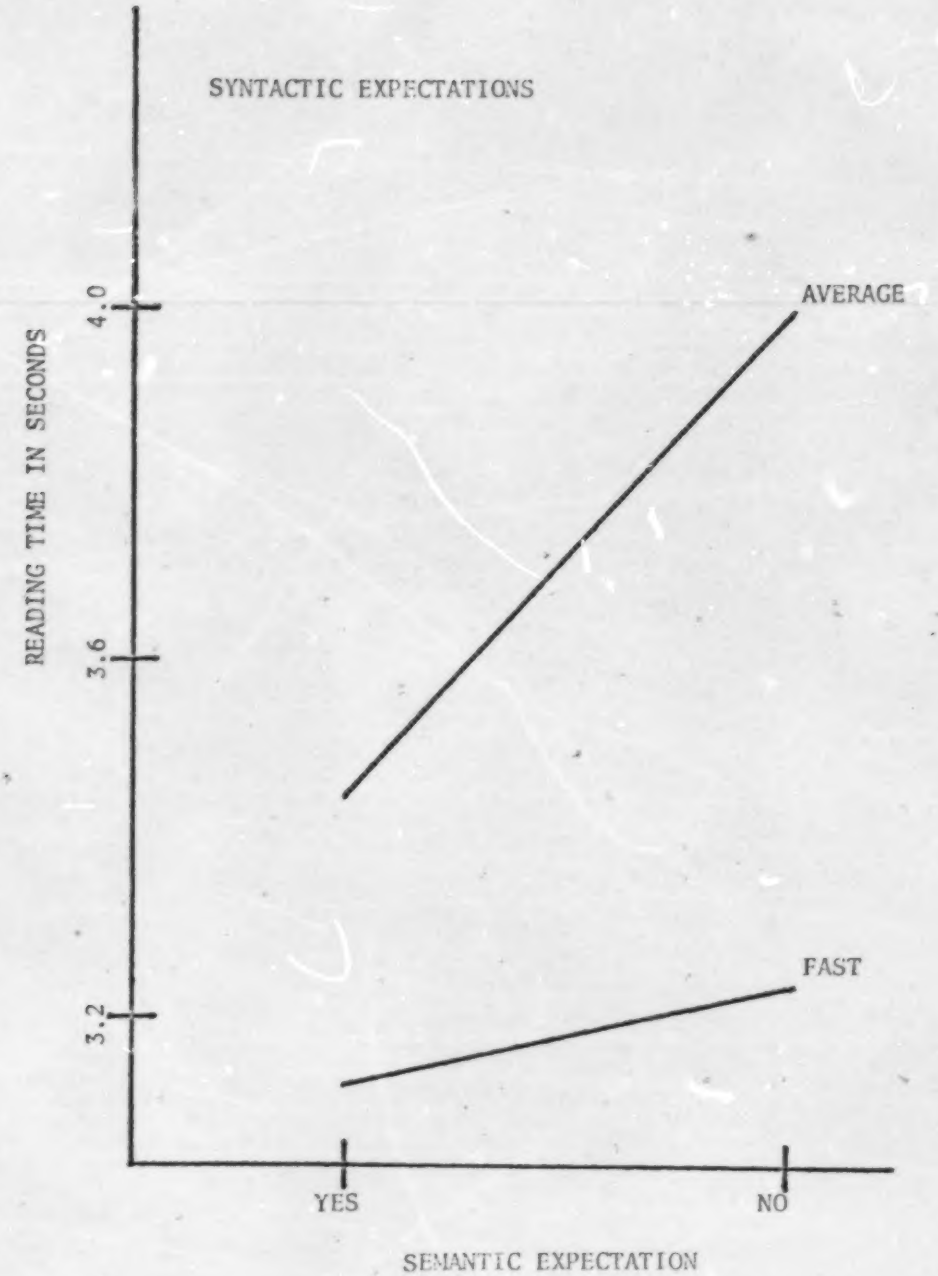
SYNTACTIC EXPECTATIONS
READING TIME IN SECONDS
4.0
3.6
3.2
AVERAGE
FAST
YES
NO
SEMANTIC EXPECTATION

TABLE 1

Examples of Stories in Experiment

Story A. (reaction sentence in Style 1)

Context : A lady is walking by the fruits in the market.

Event : A banana is lying in her path.

Reaction : Never on watch, she slips on the peel, bangs her head, and cries in pain.

Story B. (reaction sentence in Style 1)

Context : The train was about to depart.

Event : A family had arrived too late.

Reaction : Being disgusted, they left the station, rented a car, and drove away.

Story C. (reaction sentence in Style 2)

Context and Event same as Story A

Reaction : Since she was not watching, the lady slipped on the peel.

Story D. (reaction sentence in Style 2)

Context and Event same as Story B

Reaction : Although they were disgusted, they decided to rent a car.